Predictive Analysis

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Full Service Acquisition Impact

Scope of work

- *All major weapons system programs*
- *$1,173B in Contract "Face Value"*
- *$129B Unliquidated Obligations*
- *335,000 Contracts*
- *16,000 Contractors*
- *Flight Operations (1200 Aircraft/yr)*
- *$86B Government Property*
- *$8B Progress Payments*
- *$12B Performance Based Payments*
- *$37B in Small Business subcont. plans*

Span of Control

- *11,000 Professionals*
- *Over 800 Locations Worldwide*
- *50 Major Field Commands*
- *$1.1B Budget Authority*
- *$81M Reimbursable/Foreign Military Sales*
- *Combat Support Agency*

Readiness and Combat Support

The Apparent

Big Items - Big $ - High Attention

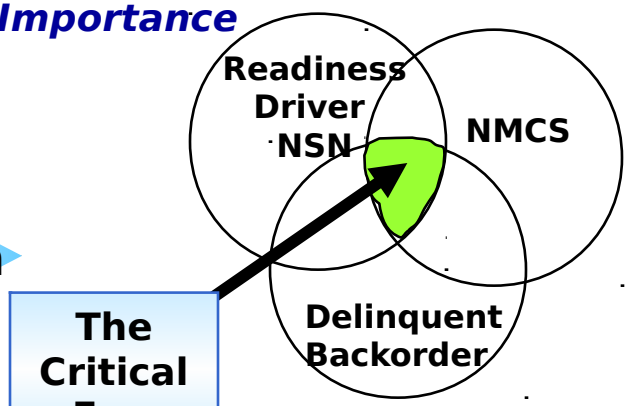
Depot Maintenance Timely Return to Mission Capable Stat

DCMA covers…

The Full Spectrum

The Less Apparent

Small Items - Small $ - *High Importance*



Informed Engagement on Spares

- **Combat Support Agency**
- **Focus on Customer's Readiness**
- **Portals to Customer's Supply Chain**

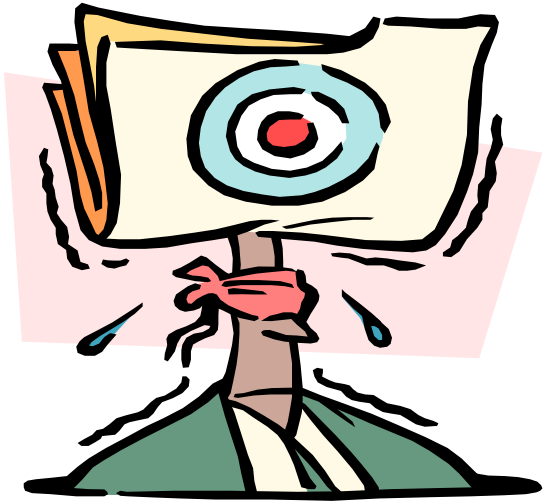
Predictive Analysis - *What* it is?

Predictive Analysis is:

the *collection*, *examination* and *synthesis* of information and data from our on-site presence which states (in terms of future cost, schedule and performance) *what we forecast will happen* based on our *special knowledge* of the supplier and program

Predictive Analysis - What it is *NOT*

- Wild Guess
- Throwing Darts
- Unsupported opinion
- Shot in the dark



- *It is not a certainty - our goal is to inform the right people early, which may prevent the event!*

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Why Predictive Analysis?

Customer Issues & Concerns?

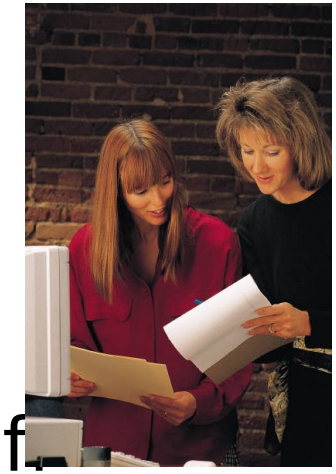
More Predictive Insight into*:*

- Systems & Software Engineering – *Technical Risk*
- Schedule Surveillance – *Critical Path*
- Quality – *Product/Process impact*
- Direct/Indirect Cost Visibility - *Rates*
- Total Ownership Cost- *Sustainment*
- Change Management – *Configuration*
- EVM – *Cost & Schedule integrated with Technical Performance*

Predictive Analysis

Tell Customers
what they don't already know!

Program Manager already has:



- Technical Data
- Status Reports & Plans
- Integrated Master Schedule
- Full Technical and Business Staff
- Cost Performance Report (CPR)
- wInsight (or some other software tool)

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Predictive Analysis

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Underlying Premise

“The quality of a product is largely determined by the quality of the process that is used to develop and maintain it.”

Based on TQM principles as taught by Shewhart, Juran, Deming and Humphrey

Why Focus on Process?

Critical Program Performance Problems[1]

Identified Issues	Relative Occurrence
Process Capability	91%
Organizational Management	87%
Requirements Management	87%
Product Testing	83%
Program Planning	74%
Product Quality – Rework	70%
Systems Engineering	61%
Process Compliance	52%
…	…

[1] Tri-Service Assessment Initiative Phase 2 Systemic Analysis Results, Jan 03

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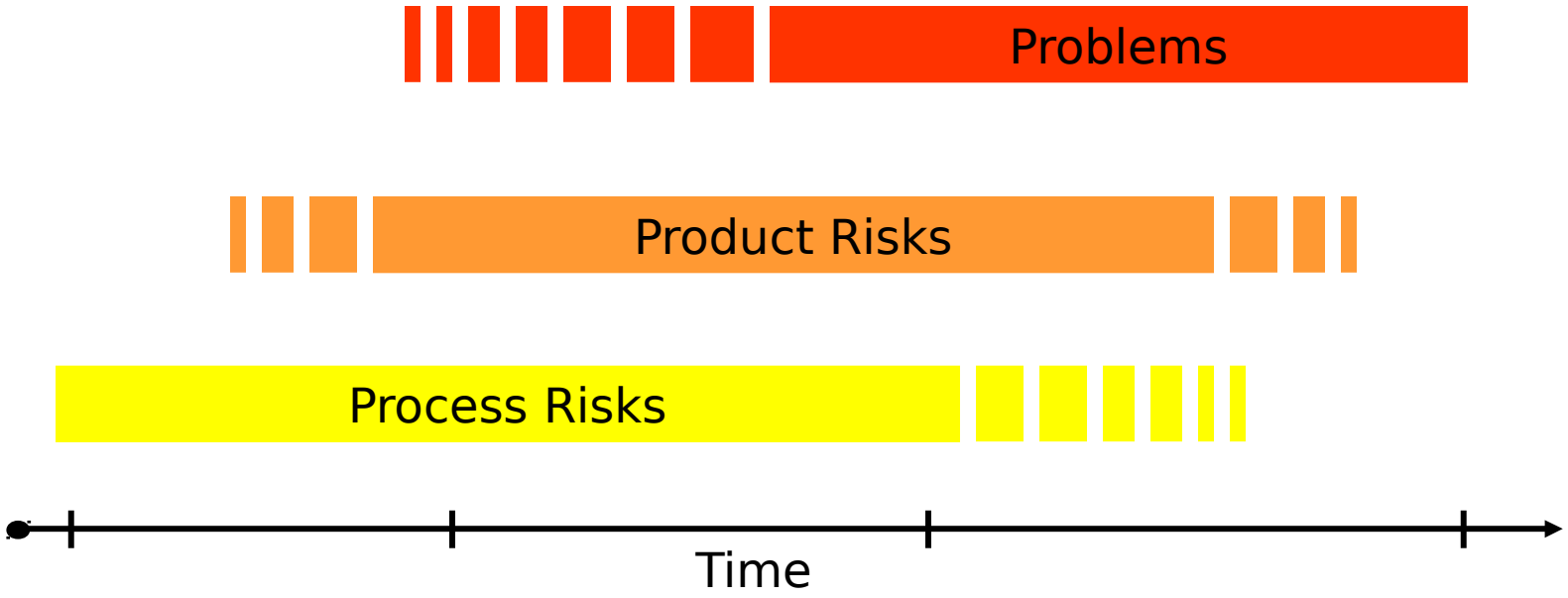
Risk Management & Problem Tracking Continuum



“A ‘Problem’ Is A Risk Whose Time Has Come”

Evaluating Process Risk Permits More Timely & Efficient Mitigation

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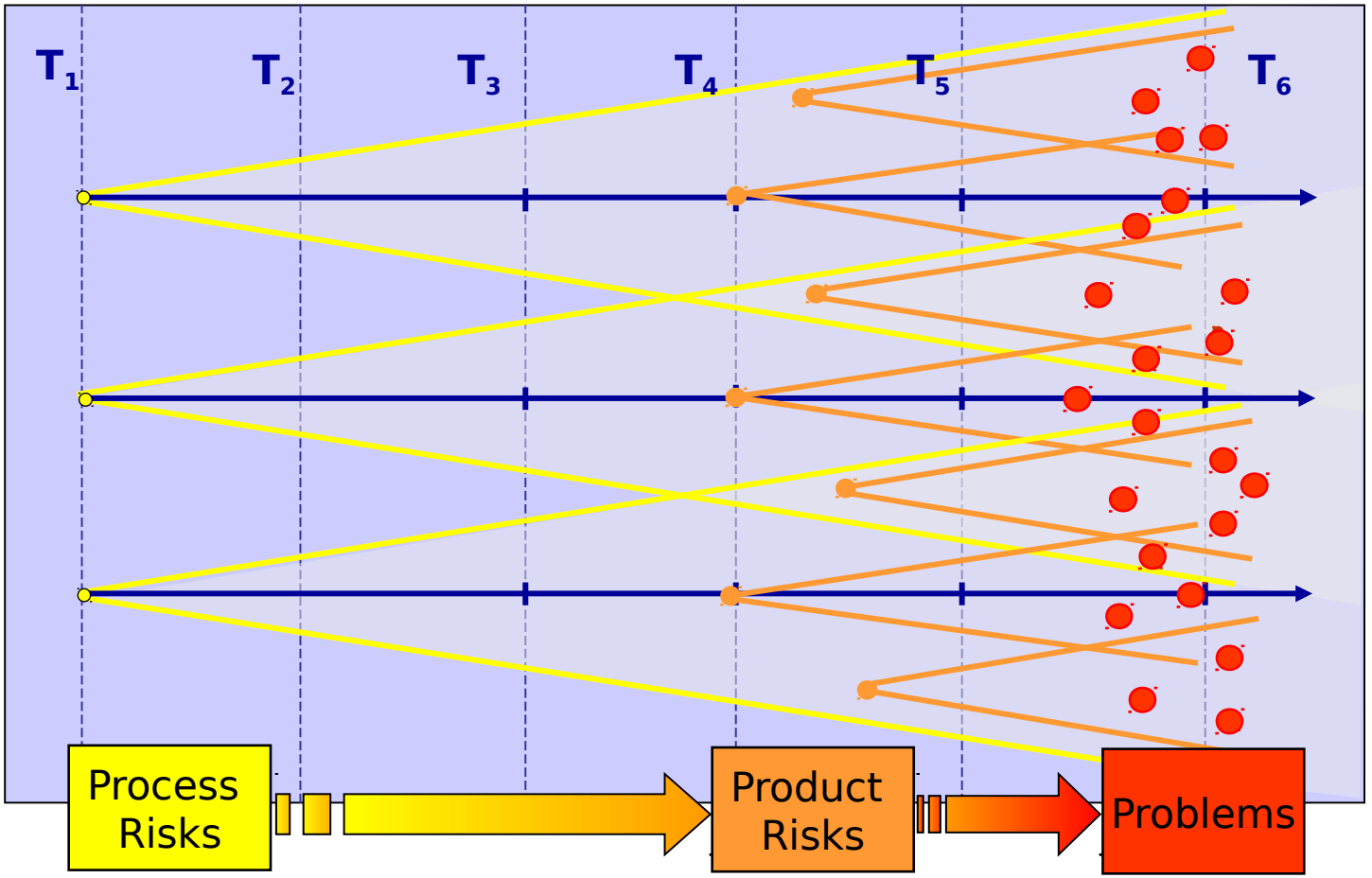
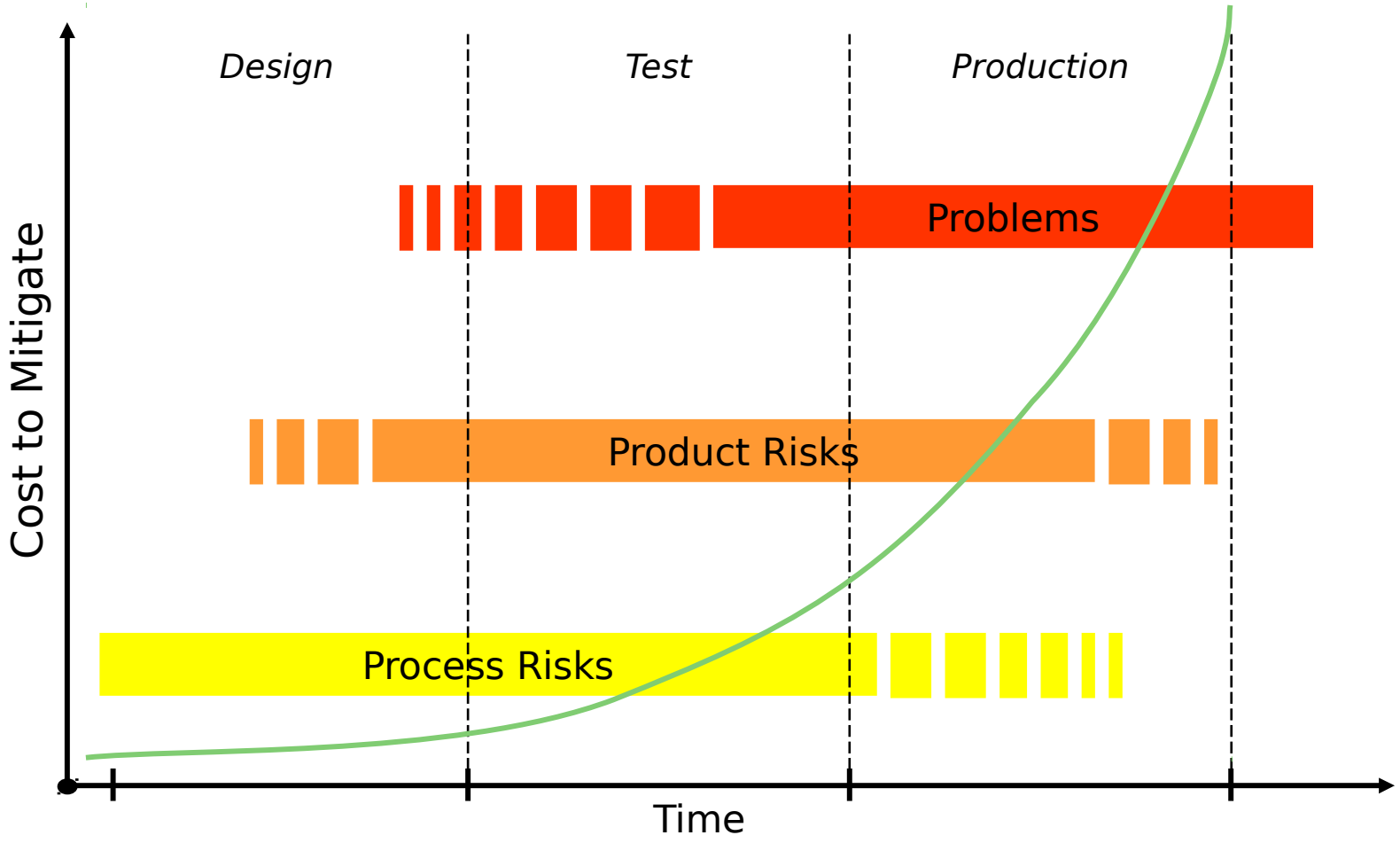


The Accuracy in Predicting Consequence Varies Over Time

Cost To Mitigate Increases Exponentially



Risk Management or Damage Control?

Predictive Analysis vs. Corrective Action

Is it a Risk .....or a Problem

Preventive	*Action* →	Corrective
May occur	*Problem* →	Has occurred
Strategic	*Thinking* →	Tactical
Long	*Time horizon* →	Short

Manage Risk and Future Issues

(Predictive Analysis)

Manage Problem and Future Impact

(Corrective Action)

Steps to Making Predictions

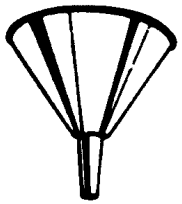
Plan Surveillance

Plan surveillance activities in a risk based approach

Apply Measures & Collect Data

Apply measures process to collect data
from all available sources

Analyze Data



Analyze/synthesize data collected in a teamed environment. You may need several sources to come to a conclusion

Generate Predictive Statement(s)

Data Sources Available

- Schedule analysis
- Critical Path analysis
- TPM analysis
- TRL assessments
- Company Capability indicators (Maturity)
- EVMS analysis
- Quality Process reviews
- Product/Process audits
- Technical System reviews
- Water Cooler talks
- Scrap & Rework and Yield data
- Business Systems reviews
- SPI inputs
- Quality Delegation reports
- PST Member surveillance
- PST Program Risk assessments
- Contractor Capability *Special Knowledge*
- Software Surveillance results
- Payment Requests
- Requests for STE and baseline changes
- *Intuition and critical thinking*

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Predictive Analysis Tools

- CMMI
- TPMs
- TRLs
- Design Iterations
- Complexity
- How much Systems Engineering?
- Business Processes – Billing, Estimating Accounting
- Earned Value
- IEAC
- Integrated Master Schedule
- Critical Path
- Quality Assurance – Performance data and analysis
- Best Manufacturing Center of Excellence
- Integrated Spreadsheet
- Predictive Models

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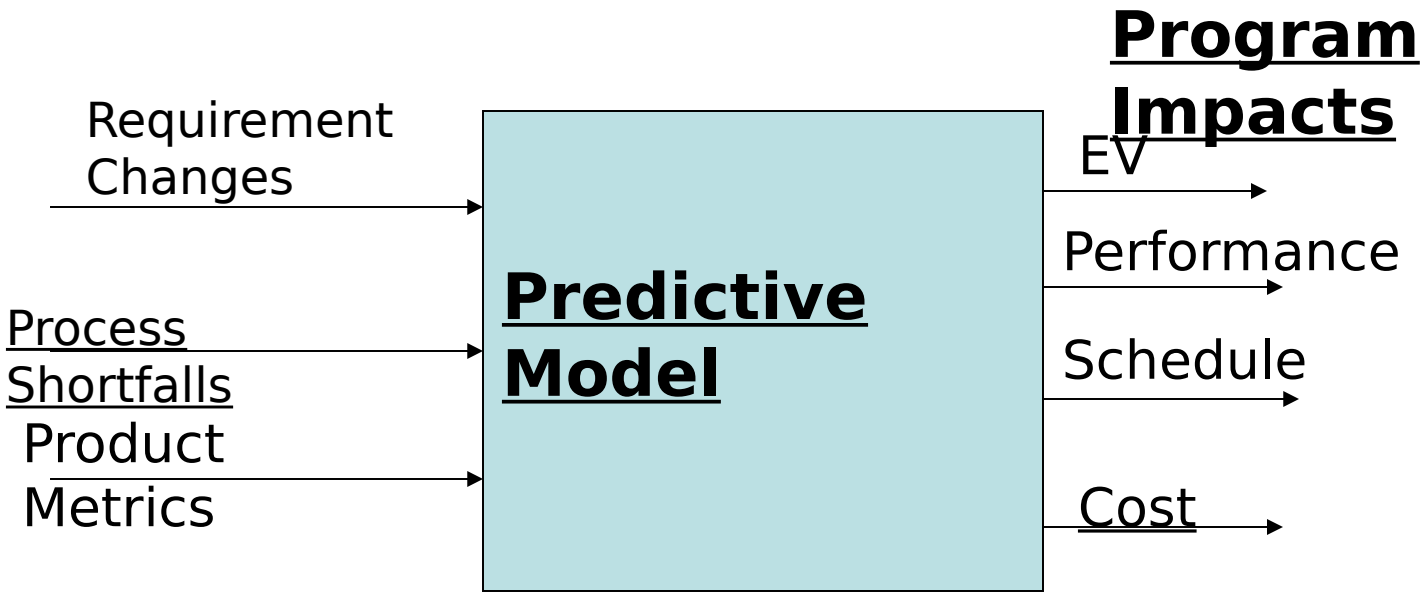
Summary

- Customers want Predictive Analysis
- Need to forecast future problems
- To be truly predictive, one needs to look at the processes used to create the various products

Future PA Tools

- Creation of Predictive Models



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Capability Maturity Model Integrated (CMMI)

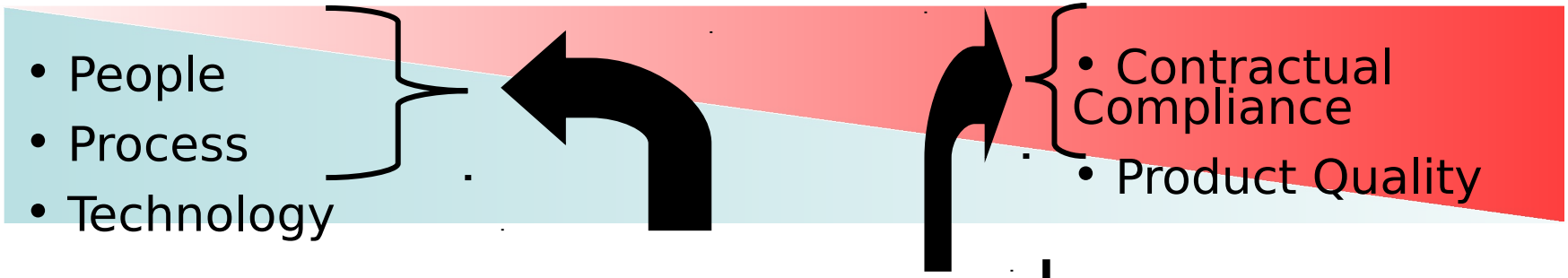
At contract award:

- Little known about product…BUT can:
  - Estimate “capability” of supplier
  - Identify & assess risks
  - Identify process improvement opportunities

CMMI CAN SUPPORT BOTH!

As contract is executed:

- Emphasis changes from “capability” to “performance”
- Contract surveillance needs to reflect this by:
  - Evaluating actual process “performance”
  - Monitoring achievement of process improvement objectives
  - Identifying new process improvement opportunities



CAPABILITY vs PERFORMANCE!

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What Does the CMMI Cover?

Category	Process Area
Project Management	Project Planning Project Monitoring and Control Supplier Agreement Management Integrated Project Management Integrated Supplier Management Integrated Teaming Risk Management Quantitative Project Management
Support	Configuration Management Process and Product Quality Assurance Measurement and Analysis Causal Analysis and Resolution Decision Analysis and Resolution Organizational Environment for Integration
Engineering	Requirements Management Requirements Development Technical Solution Product Integration Verification Validation
Process Management	Organizational Process Focus Organizational Process Definition Organizational Training Organizational Process Performance Organizational Innovation and Deployment

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Systems Engineering and Software

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Questions to consider on your program

- Is Systems Engineering *applicable to the program*?
- Does the program include *Software Engineering*?
- Does the supplier have any *process* weaknesses?
- Are the *Requirements* stable?
- How *Complex* is the program?
- What is the *Technology Readiness Level*?
- Are there numerous *Design* iterations?
- Do the *Technical Performance Measures* (TPMs) have a planned profile?

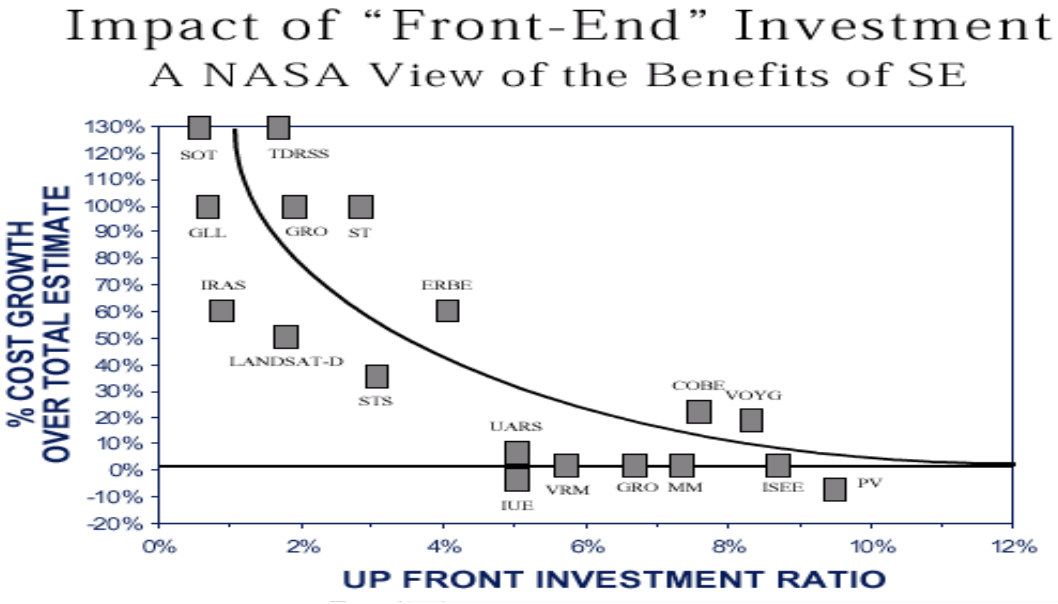
Can you be predictive?

Stressing the need for good SE

How much is needed?

- NASA study showed programs are less likely to experience cost and schedule overruns when at least *5% to 10% of program funds* are allocated to systems engineering

Source: NASA Comptroller's Office, 1985



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Module 3.5

Earned Value Management

Program Support Team (PST) Role in EV

- The PST should use EV as a tool for making predictions, *not simply repeating the Cost Performance Report (CPR) data*
- The PST report should provide an independent estimate at complete *(IEAC)*
  - The IEAC should include supporting rationale
- The PST's report should *relate variances with analysis results* (e.g. floor findings, critical path, TPMs, TRLs, etc)

IEAC

IEAC can be *predictive*

PMO Has Formula *Special Knowledge*

- IEAC= ACWP + (work remaining) + (cost growth)

(performance factor)

- Cost growth due to:
  - Schedule slip
  - Added labor
  - Added requirements
  - Supplier delays and cost growth
  - Redesign
  - etc.

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Summary

- *Each member of the PST* plays an important role in the
  - Analysis of EV data
  - Predictions of future status
  - Programmatic risk mitigation efforts
- EV is just one of *multiple sources of data* synthesized by the PST in predictive analysis
- Predictive analysis *should be the objective* for all EVMS analysis

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Integrated Master Schedule

IMS Analysis

The IMS *should be the framework* for program reviews and assessments

- Are the schedules shown during the review representative of what is happening on the program?
- Are problem areas identified and discussed?

Predictive Analysis

- By viewing the dependencies identified on the IMS, you can forecast how schedule problems on one WBS will impact other WBS elements

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Benefits of IMS

Key benefits:

- Identification of critical path
- Precedence based depiction of tasks
- Resource leveling capability
- Revised completion date estimates based on status

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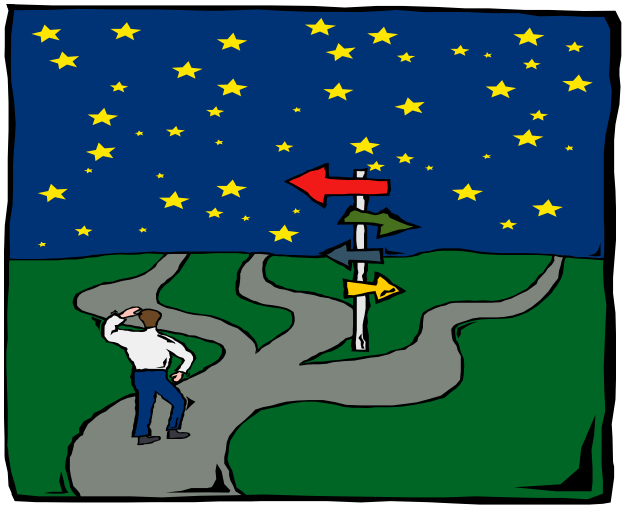
The Critical Path



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Critical Path Analysis

- Know which WBS elements are on or near the Critical Path
- Compare them with the actual performance
  - *If tasks are delayed and near/on CP, then this is a high risk area that must be managed*
  - *If tasks are shown as 'on schedule' yet you are aware of performance issues, investigate why CP does not reflect delay*
- Do you think the planned Corrective Action will have the desired effect on the Critical Path schedule?
- Has the Corrective Action that was taken last month and this month had the intended impact?

Preparing Your Assessment

Is what you know about the progress reflected in the schedule?

- Examine Control Account Plans and detailed schedules

Do you believe the schedule remaining for a task is sufficient?

Examine Horizontal Dependencies

- Are the dependencies tied properly so that a slip on one dependent activity reflects on the other activity?

Examine Vertical Dependencies

- Are slips in the detail level critical path reflected in

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Module 3.7

Quality Assurance

QAS Inputs to PST

What can the QAS provide to the PST?

- Performance Data and Analysis
- Test information/results
- Trends
- Bottlenecks *
- Scrap/Rework
- Subcontracting effort/issues
- Contractor Personnel Skill Level
- Management/Labor Insights

* **QAS sometimes acts as a production specialist**

PA Statements – Positive & Negative

Predictive Analysis takes under consideration what is *strong or weak* about a contractor's process

Predictions should trace directly to:

- Strengths & Weaknesses of the contractor's process and the words used in our predictions should effectively communicate Strengths and Weaknesses as the **rationale** for such a prediction

- Similarly…Changes or Adjustments to our in-plant activities should be based on the same observed strengths and weaknesses -- with a customer centered focus on working with the contractor to improve

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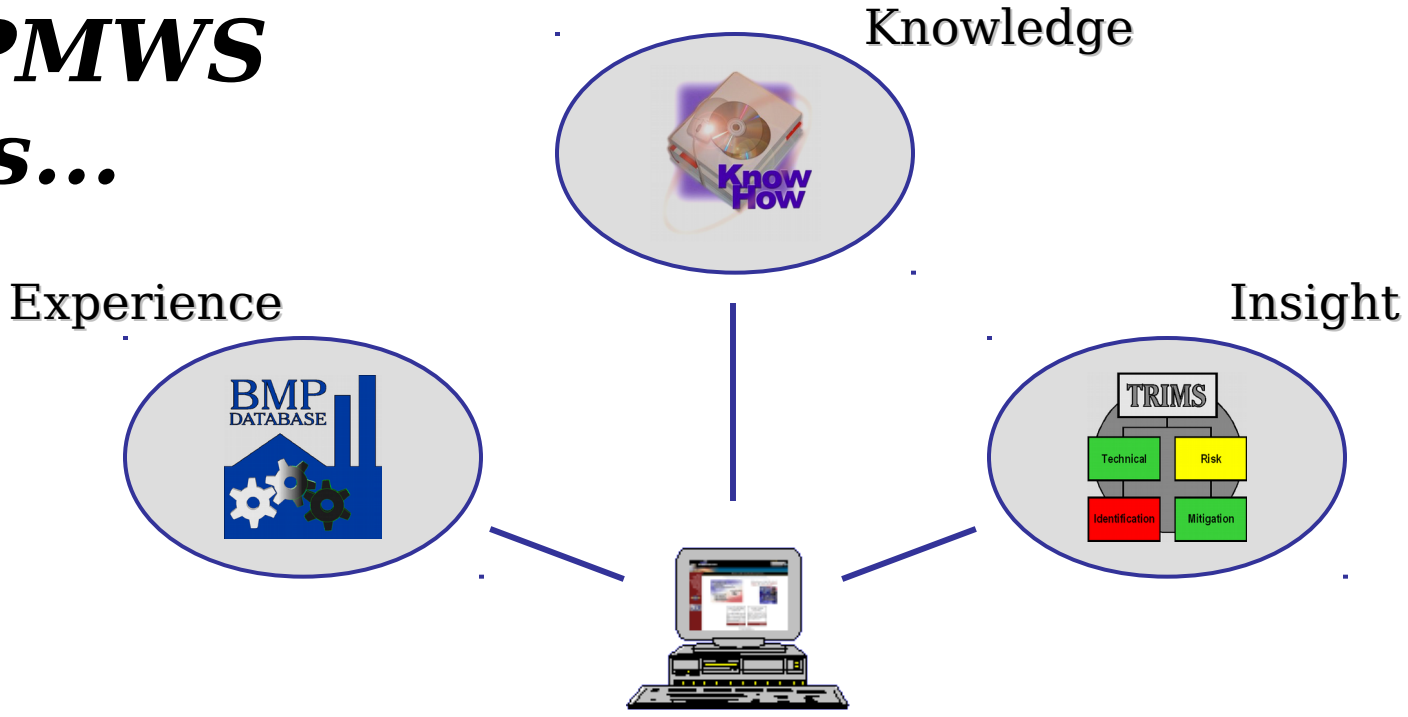
Program Manager's WorkStation

PMWS is…



Your Electronic Consultant!

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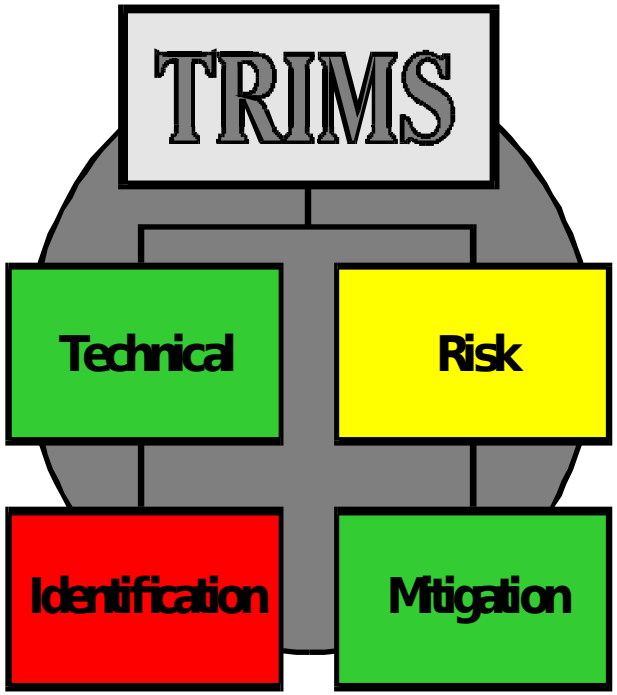

"Insight"

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Tailoring TRIMS To Your Needs

- Identify Risks Before they Become Problems
- Build YOUR Knowledge into TRIMS
  - Use the Systems Engineering Knowledge Base as a Starting Point for A Good Engineering Process
- Create a Concrete, Repeatable Process for Evaluating & Comparing Programs & Contractors
- Ease the Learning Curve for New Employees
- Retain Knowledge of Lost Employees
- Share Knowledge
- To Maximize Benefits of Using TRIMS
  - Apply as Early as Possible in Program Life
  - Apply to All Subcontractors, Divisions & Vendors Involved
  - Use Tool Regularly to Prioritize Resources & Make Decisions

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Other Measurements

- Major milestone exit criteria (e.g. PDR, CDR)
  - *If these slip, all subsequent events are impacted*
- Drawing release
  - *This is an excellent early indication of schedule validity*
- Number of changes per drawing
  - *If the drawing change rate exceeds the planned change rate, then the amount is design effort will be higher than budgeted*
- Dependency
  - *Number of sub-contracted items and their complexity*
- Stability
  - *Anticipated changes due to external or internal factors*

How Does it All Fit Together?

WBS Number					Critical Path?	Priority	CMMI PAs												Metrics						Schedule Impact
L1	L2	L3	L4	L5			PP	PMC	RSKM	IPM	IT	SAM	ISM	QPM	REQM	RD	TS	PI	VER	VAL	CMMI	TRL	Complexity Level	TPM 1	CPI (Cum)	SPI (Cum)	
100000																											
	120000																										
		122000																									
			122100																								
				122110	Y	1																3	H		1.13	1.00	1 week
				122120	N	2																3	H		0.74	1.00	
				122130	Y	1																3	H		1.68	0.84	
				122140	N	2																3	H				4 weeks
				122150	Y	1																3	H		1.03	1.02	
				122170	N	2																3	H		0.90	0.95	2 weeks
				122180	Y	2																3	H		0.98	0.96	3 weeks
				122190	N	3																3	H		1.21	1.00	
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Prototype Integrated Spreadsheet

Tying it All Together